

CLAIMS

WE CLAIM:

1. A process control instrument comprising:
  - 2 a control for generating or receiving a high frequency signal;
  - a waveguide comprising a cylindrical housing closed at one end by a rear wall;
  - 4 a loop launcher operatively connected to the control and comprising a wire having  
a first straight leg electrically connected at one end to the control and extending into the  
6 waveguide a first select length, a second straight leg connected at one end to the rear wall and  
extending into the waveguide a second select length, greater than the first select length, and a  
8 curved middle section connecting other ends of the first and second straight legs; and  
an antenna operatively coupled to the waveguide.
2. The process control instrument of claim 1 wherein the second leg is  
2 located at a center axis of the waveguide.
3. The process control instrument of claim 1 wherein the first leg is located  
2 off center in the waveguide.

4. The process control instrument of claim 1 wherein the first select length is  
2 about a quarter wavelength.
5. The process control instrument of claim 1 wherein the waveguide has a  
2 length of about three-quarter waveguide wavelength.
6. The process control instrument of claim 1 wherein the curved middle  
2 section has a radius of about 10mm.
7. The process control instrument of claim 1 wherein the loop launcher is  
2 asymmetrically placed entirely on one side of an axis of the waveguide.
8. The process control instrument of claim 1 wherein the first leg is parallel  
2 with the second leg.
9. The process control instrument of claim 1 wherein the waveguide is filled  
2 with a dielectric material substantially surrounding the loop launcher.
10. The process control instrument of claim 1 further comprising a coupling  
2 cavity surrounding the waveguide for coupling the antenna to the waveguide.

11. The process control instrument of claim 10 wherein the coupling cavity is
- 2 formed of metal to define an intermediate waveguide.

12. A process control instrument comprising:

a control for generating or receiving a high frequency signal;

a waveguide comprising a cylindrical housing open at a distal end and closed at an

inner end by a rear wall;

a loop launcher operatively connected to the control and comprising a wire

electrically connected at one end to the control and extending into the waveguide and connected at another end to the rear wall;

a coupling cavity comprising an open cylinder surrounding the waveguide and extending beyond the waveguide open end; and

an antenna operatively coupled to the coupling cavity and the waveguide.

13. The process control instrument of claim 12 wherein the coupling cavity

extends beyond the waveguide open end a length in a range of about 7, 9, 11 or higher odd multiples of quarter waveguide wavelength.

14. The process control instrument of claim 12 wherein the coupling cavity is

of metal construction.

15. The process control instrument of claim 14 wherein the coupling cavity

comprises a process connection.

16. The process control instrument of claim 12 wherein the loop launcher  
4 comprises a wire having a first straight leg electrically connected at one end to the control and  
extending into the waveguide a first select length, a second straight leg connected at one end to  
6 the rear wall and extending into the waveguide a second select length, greater than the first select  
length, and a curved middle section connecting other ends of the first and second straight legs

17. The process control instrument of claim 12 further comprising a union nut  
2 operatively secured to the waveguide for threading relative to the antenna at any angular  
orientation.

18. A process control instrument comprising:

a housing;

a control in the housing for generating or receiving a high frequency signal;

an antenna including a coupling element for securing to a process vessel to define  
a process seal; and

a universal connector operatively connecting the housing to the antenna,  
comprising a waveguide operatively secured to the housing, a loop launcher in the waveguide  
operatively connected to the control, and a union nut operatively secured to the waveguide for  
selectively threading the waveguide to the antenna at any angular orientation without affecting  
the process seal.

19. The process control instrument of claim 18 wherein the waveguide is  
rotatably mounted to the housing so that the housing and the loop launcher can be independently  
oriented relative to a process vessel.

20. The process control instrument of claim 18 wherein the union nut is  
operatively secured to the waveguide assembly with a snap ring.

21. The process control instrument of claim 18 wherein the waveguide  
2 comprise a two piece assembly including a waveguide adapter operatively secured to the housing  
and a waveguide adapter tube extending from the waveguide adapter and defining the cylindrical  
4 housing so that the waveguide adapter defines the rear wall.

22. The process control instrument of claim 21 further comprising a conductor  
2 passing through the waveguide adapter for connecting the loop launcher to the control.

23. The process control instrument of claim 21 wherein waveguide adapter  
2 tube includes an annular shoulder and the union nut is operatively secured to the waveguide  
adapter tube between the shoulder and a snap ring.

24. The process control instrument of claim 18 wherein the loop launcher  
2 comprises an asymmetrical wire electrically connected at one end to the control and extending  
into the waveguide and connected at another end to a rear wall of the waveguide.

25. A process control instrument comprising:

a housing;

a control in the housing for generating or receiving a high frequency signal;

a waveguide comprising a cylindrical housing closed at one end by a rear wall;

a loop launcher operatively connected to the control and comprising a wire

electrically connected at one end to the control and extending into the waveguide and connected at another end to the rear wall to develop an asymmetrical radiated electromagnetic field;

an antenna operatively coupled to the waveguide; and

means for rotatably mounting the waveguide to the housing so that the housing

and the loop launcher can be independently oriented relative to a process vessel.

26. The process control instrument of claim 25 wherein the means for

rotatably mounting the waveguide to the housing comprises a waveguide adapter defining the rear wall of the waveguide and having a thread received in a threaded opening of the housing.

27. The process control instrument of claim 26 wherein a set screw in the

housing maintains the waveguide adapter in a desired rotational position.



28. The process control instrument of claim 25 wherein the waveguide  
2 comprise a two piece assembly including a waveguide adapter operatively secured to the housing  
and a waveguide adapter tube extending from the waveguide adapter and defining the cylindrical  
4 housing so that the waveguide adapter defines the rear wall.

29. The process control instrument of claim 28 further comprising a conductor  
2 passing through the waveguide adapter for connecting the loop launcher to the control.

30. The process control instrument of claim 25 further comprising a union nut  
2 operatively secured to the waveguide for threading relative to the antenna at any angular  
orientation so that the housing and the loop launcher can be independently oriented relative to a  
4 process vessel.

31. The process control instrument of claim 30 wherein the waveguide adapter  
2 tube includes an annular shoulder and the union nut is operatively secured to the waveguide  
adapter tube between the shoulder and a snap ring.

32. The process control instrument of claim 25 wherein the loop launcher  
2 comprises an asymmetrical wire.

33. The process control instrument of claim 25 wherein the loop launcher
- 2 comprises a wire having a first straight leg electrically connected at one end to the control and  
extending into the waveguide a first select length, a second straight leg connected at one end to
- 4 the rear wall and extending into the waveguide a second select length, greater than the first select  
length, and a curved middle section connecting other ends of the first and second straight legs.

34. A process control instrument comprising:

a housing;

a control for generating or receiving a high frequency signal comprising a

waveguide operatively secured to the housing, and a loop launcher in the waveguide operatively connected to the control;

an antenna including a coupling element for securing to a process vessel to define a process seal; and

a connector operatively connecting the housing to the antenna comprising a nut operatively secured to the waveguide for selectively threading the waveguide to the antenna

without affecting the process seal.

35. The process control instrument of claim 34 wherein the waveguide is

rotatably mounted to the housing so that the housing and the loop launcher can be independently oriented relative to a process vessel.

36. The process control instrument of claim 34 wherein the union nut is

operatively secured to the waveguide assembly with a snap ring.

37. The process control instrument of claim 34 wherein the coupling element
- 2 comprises a cylindrical sleeve receiving the antenna and a snap ring securing the antenna in the sleeve.